

CRAWFISH AS CROP DESTROYERS.

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In all lands wild animal life abounds, and as soon as the agricultural development of a region is begun, many species quickly assume beneficial or injurious relations to the growing crops. In the United States we have learned by bitter experience to recognize certain noxious species and to adopt more or less effective methods for their control. At times, however, we are confronted by the injurious activity of a species hitherto comparatively harmless to agriculture. Such species may be importations from foreign countries or from other States, or they may long have been residents of the areas where they develop noxious habits. A notable example of the latter class is a large parrot which, after the introduction of sheep into New Zealand, assumed the rôle of a bird of prey, gradually abandoning its normal food of wild fruits to feed on those helpless animals. It alighted on the sheep, tore great holes with its powerful beak, and ate the kidneys and succulent muscular tissues. Within the United States, meadow mice, which are of little economic importance in wild lands, have at times suddenly increased inordinately and have invaded extensive agricultural areas. In 1908 thousands of dollars' worth of alfalfa was destroyed in Nevada by these pests. At about the same time a species of rat, little known except to naturalists, overran the Salt River Valley of Arizona, and before it could be controlled did great damage to forage, garden crops, and fruit orchards.

DAMAGE TO CROPS BY CRAWFISH.

While birds and mammals often play the rôle of pests, it will surprise most people to learn that a species of crawfish, or crayfish, as it is sometimes called, does extensive damage to crops in certain restricted localities in the South. (Pl. XXII, fig. 1.) Heretofore, except for occasional injury, as the result of burrowing into earthen dams, dikes, or fills, crawfish were generally supposed to be of little economic importance. Moreover, in certain localities the larger kinds, especially those inhabiting streams, are somewhat extensively used as an article of food.

Very different is it in the Houston clay lands of Mississippi and Alabama, where in certain areas infested by crawfish it is almost impossible to raise any crops with profit. The formation they inhabit is a heavy gumbo soil from 4 to 15 feet in depth, well satu-

rated with water, and overlying a sandstone formation. This is an ideal home for a species of aquatic tendencies, since in the driest seasons several feet of water remain in the tunnels, and during average seasons the water level is not over 3 or 4 feet below the surface.

The planters within the region of infestation have suffered heavily for years, but it is only recently that the outside world has learned of the extensive depredations caused by this crustacean. Over a wide stretch of country, estimated at not less than 1,000 square miles, crawfish prevent to a very considerable extent the successful production of cotton and corn. They do the greatest amount of damage just after the plant appears and before secondary leaves are developed. (Pl. XXII, fig. 2.) Large fields of young cotton have been destroyed in a single night. Corn also is extensively eaten, but it not so badly damaged as cotton.

An examination of the cotton field, following a raid by crawfish, shows that they tear away the tender cotyledons and carry them to their burrows. It is not known how many plants one crawfish will destroy in a night, but at least a dozen entire leaves have been found at the entrance of a burrow, while probably an even greater number had been carried below. It would seem that the principal feeding is done underground and not during the time of gathering.

Some idea of the number of crawfish in the district may be gained from the statement that in badly infested areas there are from 8,000 to 12,000 holes to the acre. On one plantation near Muldon, Miss., 27 barrels of crawfish were picked up in a season, and the following year 13 barrels more were secured. Another planter in the neighborhood estimates that 200 barreelfuls have been picked up on his plantation in 10 or 12 years. For this enormous quantity he paid a barrel of flour or cornmeal for each barrel of crawfish.

Some cotton planters replant after the first crop is destroyed, and occasionally they thus succeed in securing a fair stand, especially in dry weather. (Pl. XXII, fig. 3.) The crawfish are much more active during showery weather than at other times. If, therefore, frequent rains occur soon after replanting, the chances for a crop are very poor, but in dry weather the plants may develop rapidly enough to be out of danger when wet weather finally appears.

Although the plants of these later crops are necessarily smaller and more backward, they will produce a fair amount of staple cotton if frost is long enough delayed.

Very little is known in regard to the breeding habits of the injurious species. Dr. A. E. Ortmann, an authority on the general subject, thinks there is only one breeding season and that the eggs are laid and the young hatched in spring. The number of young is variable, but usually increases with the age of the mother, so that females which at first have only from 50 to 100 eggs, may later in

life produce 400 eggs or more at a time. The development of the eggs requires about a month, and the young remain with their mother for from one to two weeks before starting an independent life. They grow rapidly during the first summer, molting about once a month, until they attain in fall, or beginning of cold weather, a length of approximately 2 inches. Crawfish are solitary in habits, and two are rarely found in one burrow, except during the mating season or when females are accompanied by young.

REPRESSIVE MEASURES.

On account of the large area affected and the great cost of labor and material, deep tile draining seldom has been used as a remedy against the depredations of crawfish. Theoretically, and from a few scattered experiments in other regions, it is thought that by lowering the water level partial or complete relief may be had.

As before stated, immense numbers of crawfish have been collected during rainy weather or in the evening when they leave holes and come to the surface. There is no question that if they are systematically destroyed at every opportunity they will soon cease to be a troublesome pest. Instead of attempting to catch them alive and placing them in receptacles, they can be much more quickly killed by clubs or by crushing under foot. A "shinny stick" makes an admirable weapon, as the terminal bend lies in the proper plane to make an easy and effective blow. Thus laborers can pass from row to row destroying all crawfish in sight. To be effective, the work must be carried on day and night, whenever the crawfish appear on the surface.

An important reason for collecting the crawfish, rather than leaving them to rot where killed, is that when boiled, mixed with meal, and allowed to dry they make an extremely valuable egg-producing food for poultry. Indeed so valuable is this food that if the supply of crawfish were not so dependent upon weather conditions the preparation of this product might prove a profitable commercial undertaking.

No doubt there are many poisons fatal to crawfish, but to insure cheapness our experiments were mainly confined to carbon bisulphide, chloride of lime, and calcium carbide, named in the order of their effectiveness. Chloride of lime has the advantage of being a little less expensive.

CARBON BISULPHIDE.—After many experiments it was found that two or three drops of carbon bisulphide placed in a burrow and the orifice immediately closed by pressure of the foot, kill the crawfish in the course of a few hours. The fluid can be readily inserted in the hole by using a long-nozzle oil can (commonly used by locomotive engineers) with an aperture small enough to allow the proper

amount of fluid to escape by simple depression. After a little practice a man can pass rapidly along the rows discharging a few drops of carbon bisulphide in each burrow and closing the orifice with his foot as he proceeds, thus covering a considerable area each day. The cost of the carbon bisulphide is at the rate of 1 cent to 75 holes, or from \$1 to \$1.50 per acre.

CHLORIDE OF LIME.—An ounce of a solution of chloride of lime (of the strength of 1 pound to 3 gallons of water) was found sufficient to kill the crawfish in their holes. A 10-quart sprinkling pot, fitted with an oil-can nozzle, is convenient for distributing this solution. Although the cost of enough chloride of lime to treat a certain area is only about a third of that of carbon bisulphide, the time required to make the solution and haul it to the field practically offsets its cheapness. Taking everything into consideration, therefore, chloride of lime has little or no advantage over carbon bisulphide.

CALCIUM CARBIDE.—Although calcium carbide is effective, its present cost prohibits its use in large quantities. In small fields or where few holes remain on the treated area it is useful on account of the ease of application. It can be used only in burrows that are nearly perpendicular, as otherwise it will not reach the water which is necessary for the development of the fatal gas.

LABOR COST.—On account of the innumerable inhabited holes and the care required in their treatment, the cost of labor, when extra help is necessary, is far in excess of that for material. Inasmuch, however, as the soil of the region infested by crawfish can not be satisfactorily worked during wet weather, the workers, who are generally hired by the year, may profitably be employed in killing crawfish in stormy weather. Thus the charge against labor would be only nominal.

In conclusion it may be stated that the most practicable and economical means of coping with the crawfish problem is to combine poisoning with killing the crustaceans by mechanical means. During rainy weather and at twilight in the spring after crawfish become active, the area to be planted with cotton or corn should be visited frequently, and as many as possible of the crawfish killed before seeding time. After the majority have been secured the remaining occupied burrows should be treated with poison, preferably carbon bisulphide.